THE VARIETIES OF HELIANTHUS TUBEROSUS

THE girasole, Jerusalem artichoke or sunroot, *Helianthus tuberosus* of Linnæus, has been in cultivation more than three hundred years. It is native in North America, and its tubers were well known as a source of food to the Indians in pre-Columbian times. In spite of its long history and value as a "root-crop," this plant has received little attention from breeders in modern times, and it still remains to be seen what may be done with it, with intensive study and improved methods. At the present time we can say that it is enormously prolific, and the tubers are excellent food for man and beast. Recent experiments indicate that they may be an important source of sugar in the form of syrup. The very large tops can be used as fodder. For these and other reasons it is desirable to investigate the existing varieties, and place on record their principal characteristics. This year, in Boulder, Colorado, I have grown all those listed below, excepting the first:

(*a*) *typicus*.—I take as typical of the original *H. tuberosus* the plant figured by Fabius Columna in his account of little-known and rare plants, published in 1616. This figure is cited by Linnæus. It is labelled Flos Solis Farnesianus, Aster Peruanus tuberosus, *i. e.*, the Farnesian sunflower, or tuberous Peruvian aster. It did not, of course, originate in Peru. The figure shows that the plant was much branched, the branches highly floriferous; tubers quite large, potato-shaped or oblong; leaves short-stalked, with broad base, the margin quite coarsely crenate-dentate; rays about 16, not very long; involucral bracts recurved. I have never seen a plant with exactly this combination of characters, but the peculiarities recur separately in different varieties.

(*b*) *nebrascensis*.—Received from the Rev. J. M. Bates, who found it growing wild at Red Cloud, Nebraska. It is like typicus in its general appearance, with many floriferous branches. Compared with *albus* (described below) it differs conspicuously by the shiny upper surface of leaves and the less densely hairy stems. It flowers earlier than the cultivated forms with large tubers. The heads in bud have the involucral bracts spreading (as in *typicus*), dark basally, much less hirsute than in *albus*. The ligules are much longer than in the varieties with large tubers, their length about 42 mm. (30 or less in the large-tubered forms), so the flowers are very handsome. The tubers are produced at the ends of the rhizomes, mostly distant from the stem, and are elongate, broad or narrow, cylindrical, but usually not claviform, and not compressed at end. The thin skin is pale brown.

(*c*) *alexandri*.—Growing wild in Michigan, and received from the late Mr. S. Alexander, who regarded it as a distinct species. It resembles the tall cultivated forms in not being conspicuously branched or bushy, as are the

two varieties described above. Compared with *albus* it differs by the opposite leaves, less densely hairy stem, bases of leaf-blades more abruptly truncate, yet upper part of petiole much more broadly winged; leaves longer in proportion to breadth. hairs on midrib beneath subappressed (erect in *albus*). The upper surface of leaves is dull, as in *albus*. The ligules are long, as in *nebrascensis*, and are not rarely quilled. The stigmas begin to emerge while the anthers are fully extended, which is not the case with the other forms. The tubers are elongate, at the ends of the rhizomes, claviform, subcylindrical, more or less compressed apically. They are white, with a very thin brownish skin, the color being like that of *albus*.

(*d*) *purpurellus*.—Sent out by the firm of John Lewis Childs as "Pink Helianthi." A request for information concerning its origin brought no answer. It is a small-tubered form, presumably still in the state in which it occurs wild. The mode of growth and general appearance are as in *nebrascensis*, but the leaves are perfectly dull above. The large leaves are coarsely dentate, with very broad base, but the petiole is not so broadly winged apically as in *alexandri*. The rays are long, as in *nebrascensis*. This is the first of the varieties to come into flower; one head was out on August 21. The tubers are comparatively short, fusiform, cylindrical, not much attenuate at ends; they are about 50–70 mm. long and 15–18 mm. in diameter, produced at ends of rhizomes. The color is deep pinkish-purple, as in variety *purpureus*.

(*e*) *fusiformis*.—The "Rose" variety of Sutton and Sons, Reading, England. We are indebted to the Sutton firm for kindly supplying us with material of their cultivated varieties. This is a remarkable form, very distinct from all the others. When it first comes up, it grows slowly, and tends to spread out on the ground. When mature it is about 7 feet high, only about two-thirds the height of *albus* and *purpureus*. The stems are entirely green, not purple above as in *albus*. The leaves turn yellow in the fall, without any of the red so conspicuous in *albus*. After frost, most of the stems give way somewhere above the middle and the part above hangs downward, forming an acute angle with the standing stem. This rarely occurs in *albus*, but not in *purpureus*, nor in the wild forms. The leaves are long, with a cuneate base, which is very distinctive. The margin is irregularly dentate. The involucral bracts are paler and much longer than in *albus*. The plants were just coming into flower September 22, and are later than any of the other forms. The tubers are large, of variable shape, but more or less fusiform, with only occasional lateral knobs. The diameter is about 45 mm., the length two or three times as much. The surface is pale brown, practically the color of *nebrascensis*, with a faint rosy suffusion. The tubers of one plant weighed 8 lbs.

(*f*) *albus*.—We first got this, a number of years ago, from Dreer of Philadelphia. Mr. L. Sutton tells me that his firm first offered it in 1915, having obtained it from some one who said it had been sent him by a friend in South Amreica. He believes it had not been grown in England before this. Dreer had it much earlier in this country, having obtained it from Mr. A. E. Coleman of Enonville, Va. Mr. Coleman states that he knows nothing of the origin of the variety, and hardly thinks any record was kept. This variety is very tall, and usually not very conspicuously branched. The upper

FIG. 1. *Helianthus tuberosus* var. *fusiformis* at Boulder.

part of the stem is purple, and in the fall the upper leaves turn very red. The leaves have the blades broadly angled or subcuneate at base, the larger leaves forming an angle greater than a right angle; the petioles are not broadly winged apically. Thus this differs greatly from the wild *alexandri*, and in addition the margins are sharply though rather finely dentate, while in *alexandri* they are crenate. The axillary branches have a purplish-black callus at base above; in *nebrascensis* this callus is reddish. The petioles are conspicuously longer than in *nebrascensis*. The heads in bud have the phyllaries or involucral bracts erect, not spreading as in *nebrascensis* and *typicus*. The ligules are about 30 mm. long and 9.5 broad; those of *purpureus* are considerably broader, 30 mm. long and 11 broad. The tubers are very large and knobby, irregularly subglobose, and mostly among the roots, close to the base of the stem. One plant of Sutton's white, dug Nov. 3, had 12 lbs. of tubers. The color of the tubers is white.

A subvariety of *albus*, with more deeply serrate leaves, was kindly sent by Mr. G. C. Worthen, who purchased the tubers in Boston. The growth and other characters do not differ, and the tubers are the same, the buds perhaps a little more tinged with purplish.

(*g*) *purpureus*.—Received from Sutton, who states that it is the variety long cultivated in England. It is a tall plant, with the same appearance and manner of growth as *albus*. On June 30 I noted that as compared with *albus* it had paler, larger leaves, and the veins were more impressed. It was in good flower by Sept. 22. The phyllaries are notably spreading or deflexed; the ligules are broader than in *albus*. Both *purpureus* and *fusiformis* have an orange flush at the base of the ligules, which is lacking in *albus*. The ends of the disc-bracts are broader and more hairy in *fusi-*

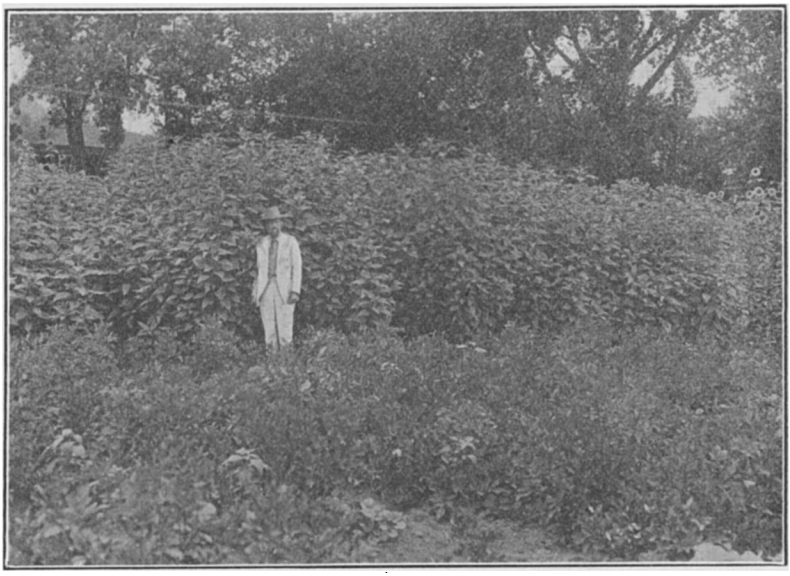

FIG. 2. *Helianthus tuberosus* var. *albus* (var. *fusiformis* at extreme left). The flowers are *Helianthus annuus*.

formis than in *albus;* in *purpureus* they are much as in *fusiformis,* but the difference from *albus* is hardly so marked. The stems show no red color. The tubers are like those of *albus,* but are rosy-purple, the same color as those of *purpurellus.* One plant produced seven lbs. of tubers.

It will be seen from the above, that all the varieties differ in a number of characteristics. At the same time, they agree in various particulars. Thus *purpureus* and *purpurellus* in the color of the tubers, *purpureus* and *albus* in their shape. We do not know how far the cultivated varieties owe their characters to aboriginal ancestors; but it is practically certain that no wild form has tubers as large as those of the cultivated ones.[1] It is also certain that the excellent (from our standpoint) character of having the tubers clustered about the crown, making them easy to harvest, could not have existed in a wild ancestor, in which it would be extremely detrimental. On the other hand, the tubers of *albus* and *purpureus* are very knobby, and so hard to prepare for the table; those of the wild forms are essentially smooth (like a sweet potato), but too small. The variety *fusiformis* combines large tubers with, at least in large measure,

[1] There is some reason for thinking that the Indians had a cultivated form with rather large tubers.

the better shape of the wild varieties. If *purpurellus,* shaped like a Zeppelin, could be crossed with another form to secure a large tuber while conserving the form, the result would be valuable. It still remains to determine the chemical constituents of the several varieties, and this will be done during the winter.

From the standpoint of genetics, an interesting feature is the distribution of the anthocyanin pigments. The variety *purpureus,* with a great quantity of anthrocyanin in the skin of the tubers, lacks this coloring in the leaves and stems. The variety *albus* has it in the leaves and stems, but not in the tubers. The physiological significance of this is at present unexplained.

One of the greatest difficulties in the way of plant breeding comes from the impossibility, in so many cases, of making sure of the history or even the identity of the varieties used. The same thing may go under several names, or the same name may be applied to different things. In the case of species, it is usually possible to unravel the synonymy by reference to the original descriptions, or to refer to the type specimens. With horticultural varieties, there is usually no type and no formal description. The history, in the majority of cases, is lost. When a new variety is introduced, the firm putting it on the market rarely states where it came from, and often, after a few years, can not recollect. There is no way to ascertain definitely that what is sold today under a certain name is identical with the plant bearing that name a number of years ago. These conditions lead to many misunderstandings and difficulties of all sorts, and to much waste of time and energy. They are no longer tolerable, when the production of new plants is of such prime importance to mankind. What we need is an organization or office, with suitable means of publication, to study and report on every plant put upon the market as new. Each should be carefully described in botanical language, and if necessary figured. Its origin, if ascertainable, should be precisely stated, with full details. Any firm refusing to submit its alleged novelties to such a test, and to permit the reports to be made, would be under grave suspicion of fraud. Not only would plant breeders be greatly benefited, but the general plant-buying public would be saved enough useless expense and annoyance to much more than pay the cost of the undertaking.

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